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IN THE MATTER OF
KOREAN PATENT APPLICATION
UNDER SERIAL NO. 51080/2001

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IN THE NAME OF : LG ELECTRONICS INC.

FOR : Turbofan, method thereof and mold manufacturing the same

IN WITNESS WHEREOF, I SET MY HAND HERETO

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[Translation]

ABSTRACT OF THE DISCLOSURE

[Abstract]

Disclosed is a turbofan, a method thereof, and a mold manufacturing the same. The turbofan includes a boss part formed at a central part so as to receive a rotational shaft of a driving device; a hub having a guide part extending from the boss part along a radial direction so as to guide airflow; a linear section part separated from the hub at a predetermined distance in an axial line direction of the rotational shaft, arranged to a side of air inflow, and formed to have an inner diameter of the linear section part which is equal to or longer than a maximum outer diameter of the hub; a step part extending from the inner diameter surface of the linear section part at a predetermined distance along the radial direction of the hub; a shroud having a curve section part curved to increase the inner diameter gradually when getting closer to the hub from the step part along the rotational axial line direction so as to guide airflow with the hub reciprocally; and a plurality of blades each of which has one end coupled with the hub and the other end coupled with the curve section part in the rotational axial line direction and which are molded to form one body with the hub and the shroud at equiangular intervals along a circumferential direction of the hub. Accordingly, a sharp edge is prevented from occurring in a mold pattern, and so durability of the mold for the turbofan fabrication is elongated.

[Representative Drawing]

Figure 5

[SPECIFICATION]

[Title of the Invention]

Turbofan, method thereof and mold manufacturing the same

[Brief description of the Drawings]

In the drawings:

FIG. 1 illustrates a layout of a turbofan according to a related art;

FIG. 2 illustrates a side cross-sectional view of the turbofan in FIG. 1;

FIG. 3 illustrates longitudinal cross-sectional views of mold patterns so as to describe a method for manufacturing the turbofan according to the related art;

FIG. 4 illustrates a magnified cross-sectional view of the assembly of a mold pattern in FIG. 3;

FIG. 5 illustrates a bird's-eye view of a turbofan according to an embodiment of the present invention;

FIG. 6 illustrates a longitudinal cross-sectional view of the turbofan in FIG. 5;

FIG. 7 illustrates longitudinal cross-sectional views so as to describe a method for manufacturing a turbofan and mold patterns thereof according to an embodiment of the present invention; and

FIG. 8 illustrates a magnified cross-sectional view of the assembly of mold patterns in FIG. 7.

**** Explanation for the major reference numerals ****

10: hub	11: boss part
12. guide part	20: shroud
21: linear section part	22: step section part

25: curve section part 30: blades

51: lower mold pattern	53, 62: hub molding part
54,63: boss molding part	55, 64: blade molding part
57: step molding part	59, 66: shroud molding part

[Detailed description of the invention]

[Object of the invention]

[Field of the invention and background art]

The present invention relates to a turbofan, a method thereof, and a mold manufacturing the same, and more particularly, to a turbofan which enables to elongate durability of a mold, a method thereof, and a mold manufacturing the same.

A turbofan is a kind of centrifugal fan sending air forcibly by a centrifugal force of air generated from revolution of an impeller thereof. The turbofan produces massive airflow so as to be suitable for a refrigerator of heavy capacity.

FIG. 1 illustrates a layout of a turbofan according to a related art. FIG. 2 illustrates a side cross-sectional view of the general turbofan in FIG. 1. Referring to FIG. 1 and FIG. 2, a turbofan according to a related art includes a hub 110 having a boss part 111 at a central part formed so as to be coupled with a rotational shaft (not shown in the drawings) of a driving device; a plurality of blades 120 separated from each other at equiangular intervals in a circumferential direction of the hub 110, thereby generating airflow; and a shroud 130 arranged at an opposite face to the hub 110, leaving the blades 120 between the shroud and the hub so as to guide airflow and be coupled with each end of the blades in one body wherein the blades 120 are inserted between the shroud 130 and the hub 110 to prevent the blades 120 from vibrating.

An internal diameter increases toward the hub 110 the axial line direction, and has

a concave shape. A cross-section of each blade 120, as shown in FIG. 1, has what is called an aerofoil figure having a convex constant-pressure surface 122A and a concave negative pressure surface 122B.

Meanwhile, such a turbofan is mainly manufactured by injection molding of synthetic resin. In some of turbofans, the blades 120 and hub 110 are formed in one body, but the shroud 130 is molded separately. Theses parts are assembled reciprocally so as to complete the turbofan.

When the turbofan is manufactured by the above process, the number of mold patterns increases, whereby consumes time and expense excessively. Besides, the above process needs a step of assembling separate parts, thereby extending a manufacturing time to increase overall cost of product.

Considering these problems, a process of manufacturing a turbofan is lately used so as to reduce the number of mold patterns and skip an auxiliary assembling step. Namely, in the latest process, a maximum outer diameter D1 of the hub 110 is reduced to a size less than a minimum inner diameter D2 of the shroud 130. And, parting line (PL) of upper and lower mold patterns are formed to be equal to the maximum outer diameter D1 so as to assemble the hub 110, blades 120, and shroud 130 in one body reciprocally.

FIG. 3 illustrates longitudinal cross-sectional views of mold patterns so as to describe a method for manufacturing a turbofan according to a related art. FIG. 4 illustrates a magnified cross-sectional view of the assembly of mold patterns in FIG. 3. Referring to FIG. 3 and FIG. 4, a molding pattern for forming a turbofan according to a related art includes a lower mold pattern part 161 arranged to be fixed to a lower part in an axial line direction of the hub 110 and having a molding surface inside to form a partial area of a hub 110 and blades 120, and an upper molding part 151 having a molding surface inside to form a partial area of the shroud 130 and blades 120 and

arranged to be reciprocally coupled with and be separated from the lower molding part 161.

A hub molding part 153 recessed upward the axial line direction is formed at a central part of a lower part of the upper mold pattern part 151 so as to form the hub 110. And, a boss molding part 154 is formed at a central part of the hub molding part 153 so as to mold the boss part 111. Along a radial direction, a blade molding part 155 is formed at an external side of the boss molding part 154 so as to form the blades 120. Along a direction of the rotational line, a shroud molding part 157 is formed over the blade molding part 155 so as to form an upper surface of the shroud 130.

Meanwhile, a hub molding part 163 protrudes out of the central part of the upper surface of the lower mold pattern part 161 so as to form a lower surface of the hub 110. A boss molding part 164 is formed at a central part of the hub molding part 153. Along a radial direction, a blade molding part 165 is formed at an external side of the hub molding part 163 so as to mold a partial area of the blades 120. And, a curved shroud molding part 167 is formed at an upper part of the blade molding part 165 so as to form a lower surface of the shroud 130.

According to such a construction, when the upper mold pattern part 151 is tightly coupled with the lower mold pattern part 161, a molding space to form the turbofan constructed with the hub 110, blades 120, and shroud 130, which are built in one body, is provided inside the lower and upper mold pattern parts 161 and 151. A molten synthetic resin is then injected in the molding space for the turbofan. After the injected synthetic resin has been hardened, the upper and lower mold pattern parts 151 and 161 are separated from each other as well as the turbofan is separated.

In manufacturing the turbofan according to the related art, the inner diameter of the shroud 130 increases when getting closer to the hub 110 along a rotational axial line

direction so as to guide airflow with the hub 110 reciprocally. The parting line, at which the lower and upper mold pattern parts 161 and 151 assemble together, is formed along the axial line direction, and a sharp edge 168 is formed at a contact between the shroud molding part 167 and the blade molding part 165 of the lower mold pattern part 161. Such a sharp edge 168, when being contacted with the upper mold pattern part 151, is damaged or distorted by a relatively small external force with ease. Hence, durability of the mold pattern is shortened.

[Technical object of the present invention]

Accordingly, an object of the present invention is directed to a turbofan which enables to elongate durability of a mold, a method thereof and a mold manufacturing the same.

[Construction of the present invention]

To achieve the objects of the present invention, a turbofan includes a boss part formed so as to receive a rotational shaft of a driving device at a central part; a hub having a guide part extending from the boss part along a radial direction so as to guide airflow; a linear section part separated from the hub at a predetermined distance in an axial line direction of the rotational shaft, arranged to a side of air inflow and formed to have an inner diameter of the linear section part which is equal to or longer than a maximum outer diameter of the hub; a step part curved to extend from the inner diameter surface of the linear section part at a predetermined distance along a radial direction of the hub; a shroud having a curve section part curved to increase the inner diameter of the shroud gradually when getting closer to the hub from the step part along the rotational axial line direction so as to guide airflow with the hub reciprocally, and a plurality of

blades each of which has one end coupled with the hub and the other end coupled with the curve section part in the rotational axial line direction and which are molded to form one body with the hub and the shroud at equiangular intervals along a circumferential direction of the hub.

At this time, a distance at which the step part extends is preferably equal to or longer than 1mm.

Moreover, an exterior step part, which is parallel with the step part, is formed between an outer diameter surface of the linear section part and an outer diameter of the curve section part. The linear section part is effectively equal to or thinner than the curve section part.

Meanwhile, in another aspect of the present invention, a turbofan includes a hub having a boss part formed so as to receive a rotational shaft of a driving device at a central part; a linear section part separated from the hub at a predetermined distance in the rotational axial line direction of the rotational shaft, arranged to a side of air inflow, and formed to have an inner diameter of the linear section part which is equal to or longer than a maximum outer diameter of the hub; a step part extending from the inner diameter surface of the linear section part at a predetermined distance along a radial direction of the hub; a shroud having a curve section part curved to increase the inner diameter of the shroud gradually when getting closer to the hub from the step part along the rotational axial line direction and be equal to or thicker than the linear section part so as to guide airflow with the hub reciprocally; and a plurality of blades each of which has one end coupled with the hub in one body and the other ends coupled with the curve section part in one body along the rotational axial line direction and which are separated/arranged at equiangular intervals along a circumferential direction of the hub. A method for fabricating a turbofan includes the steps of arranging a lower mold pattern comprising a

hub molding part for molding a lower surface of the hub on an upper surface of the hub molding part, a blade molding part protruding in the rotational axis line from one end along a radial direction of the hub molding part so as to mold a portion of each of the blades, and a shroud molding part curved for molding a lower surface of the shroud at an upper area of the blade molding part, and a step molding part extending at a predetermined distance along a radial direction of the hub so as to form a step between the blade molding part and the shroud molding part; and an upper mold pattern comprising a hub molding part for molding an upper surface of the hub on a lower surface of the hub molding part, a blade molding part formed to be inserted from a circumferential end of the hub molding part along an inner side of the blade molding part of the lower mold pattern and molding a portion of each of the blades, a linear section molding part separated from the step part at a predetermined distance in the axial line direction of the rotational shaft and having a predetermined thickness from the step part so as to mold a linear section part of the shroud, and a shroud molding part extending to be parallel with the step part at a predetermined distance and curved so as to mold an upper surface of the curve section part of the shroud; arranging so as to make the upper mold pattern and the lower mold pattern assemble together; injecting a molten synthetic in the inside space provided by the assembly of the upper mold pattern and the lower mold pattern; separating each other; and separating the molded turbofan from one of the upper mold pattern and the lower mold pattern.

Meanwhile, in another aspect of the present invention, for fabricating a turbofan includes a hub wherein a boss part formed so as to receive a rotational shaft of a driving device; a linear section part separated from the hub at a predetermined distance in an axial line direction of the rotational shaft, arranged to a side of air inflow, and formed having an inner diameter of the linear section part which is equal to or longer than a

maximum outer diameter of the hub; a step part having a predetermined thickness from the inner diameter surface of the linear section part and extending at a predetermined distance in a radial direction of the hub; a shroud having a curve section part curved to increase the inner diameter of the shroud gradually when getting closer to the hub from the step part along the rotational axial line direction and be equal to or thicker than the linear section part so as to guide airflow with the hub reciprocally; and a plurality of blades, each of which has one end coupled with the hub in one body and has the other end coupled with the curve section part in one body in the rotational axial line direction, separated/arranged at equiangular intervals along a circumferential direction of the hub. A mold for manufacturing a turbofan includes a lower mold pattern comprising a hub molding part for molding a lower surface of the hub on an upper surface of the hub molding part; a blade molding part protruding in the rotational axial line direction from one end along a radial direction of the hub molding part so as to mold a portion of each of the blades; a shroud molding part curved for molding a lower surface of the shroud at an upper area of the blade molding part; and a step molding part extending at a predetermined distance along a radial direction of the hub so as to form a step between the blade molding part and the shroud molding part, and an upper mold pattern comprising a hub molding part for molding an upper surface of the hub on a lower surface of the hub molding part; a blade molding part formed to be inserted from a circumferential end of the hub molding part along an inner side of the blade molding part of the lower mold pattern and molding a portion of each of the blades; a linear section molding part separated from the step part at a predetermined distance in the axial line direction of the rotational shaft and having a predetermined thickness from the step part so as to mold a linear section part of the shroud; and a shroud molding part extending to be parallel with the step part at a predetermined distance and curved so as to mold an

upper surface of the curve section part of the shroud.

Hereinafter, the present invention will be described in detail with reference to accompanying drawings.

FIG. 5 illustrates a bird's-eye view of a turbofan according to an embodiment of the present invention. FIG. 6 illustrates a longitudinal cross-sectional view of the turbofan in FIG. 5. Referring to FIG. 5 and FIG. 6, a turbofan according to an embodiment of the present invention includes a hub 10 having a boss 11 at a central part so as to receive to be coupled with a rotational shaft of a driving device, a shroud 20 separated/arranged from the hub 10 in an axial line direction at a predetermined distance so as to guide airflow with the hub reciprocally 20, and a plurality of blades 30, each of which has one end coupled with the hub in one body and has the other end coupled with the curve section part in one body in the rotational axial line direction, separated/arranged at equiangular intervals along a circumferential direction of the hub.

The hub 10 includes a boss part 11 protruding along an axial line direction so as to receive to be coupled with the rotational shaft (not shown in the drawings) of the driving device and a guide part 12 extending along a radial direction of the boss part 11 so as to guide the flow of air inflow.

Each of the blades 30 has an aerofoil figure as a cross-section of each blade so as to have a convex constant-pressure surface 31A and a concave negative pressure surface 31B. The length of each blade is arranged in an axial line direction of the hub 10 and separated/arranged at equiangular intervals along a circumferential direction of the hub 10.

Meanwhile, the shroud 20 includes a linear section part 21 whose inner diameter D1 of the linear section part is formed to be equal to or longer than a maximum outer diameter D2 of the hub 10 and whose inner diameter surface is formed to be parallel with

an axial line of the hub 10 so as to form a section of a predetermined distance, a step part 22 curved to extend from one end to the hub 10 side of the linear section part 21 at a predetermined distance along a radial direction of the hub, and a curve section part 25 curved to increase the inner diameter of the shroud gradually when getting closer to the hub from the end of the step part 22 along the axial line direction. At this time, the linear section part 21 has reduced thickness T1 compared to thickness T2 of the step part 22 and the curve section part 25. According to one embodiment of the present information, the inner diameter D1 is formed to be the same as the maximum outer diameter D2 of the hub 10. A length L1 of a lower part surface 23A of the step part 22 extending from the inner diameter surface of the linear section part 21 along a radial direction is preferably equal to or longer than 1mm, considering the extent of the damage and distortion of the mold pattern to be described later and airflow.

FIG. 7 illustrates longitudinal cross-sectional views of a method for and mold for manufacturing a turbofan according to an embodiment of the present invention. FIG. 8 illustrates a magnified cross-sectional view of the assembly of mold patterns in FIG. 7. Referring to FIG. 7 and FIG. 8, a mold for manufacturing a turbofan according to the present invention includes an upper mold pattern 61 and a lower mold pattern 51 which form a molding space inside for manufacturing a turbofan by assembling together. One of the upper mold pattern 61 and the lower mold pattern 51 is arranged to be fixed to something, while the other is detachable by assembly/disassembly the axial line direction of the hub 10. Here, a turbofan according to the present invention will be described by taking the case that the lower mold pattern 51 is fixed to something and the upper mold pattern 61 is arranged to be detachable by assembly/disassembly along the axial line of the hub 10 for example.

An upper surface of the lower mold pattern 51 has a hub molding part 53, a blade

molding part 55, and a shroud molding part 59 so as to mold the hub 10, blades 30, and shroud 20 respectively. A central part of the hub molding part 53 protrudes upward in the axial line direction, and a boss molding part 54 protrudes from an upper area of the hub molding part 53 so as to mold an inner diameter surface of the boss part 11. The blade molding part 55 protrudes upward the axial line direction from one end of the hub molding part 53 along a radial direction of the hub molding part 53, and forms a portion of each of the blades 30. At an upper part of the blade molding part 55, formed are a step molding part 57 extending at a predetermined distance along a radial direction and a shroud molding part 59 curved downward so as to mold a lower surface 23A of a step part 22 and a lower surface of a curve section part 25 of a shroud 20.

A lower surface of the upper mold pattern 61 has a hub molding part 62, a blade molding part 64, and a shroud molding part 66 so as to mold the hub 10, blades 30, and shroud 20 respectively.

The hub molding part 62 is recessed upward from a central part of the lower surface of the upper mold pattern 61 so as to mold the upper surface of the hub 10, and a boss molding part 63 is formed at a central area of the hub molding part 62. At one end of the hub molding part 62 along a radial direction of the hub molding part, a blade molding part 64 having an outer diameter similar to the maximum outer diameter D2 of the hub 10 is formed so as to enable to be sliding-inserted along an inner side of the blade molding part 55 of the lower mold pattern 51 and mold a portion of each of the blades. At an upper part of the blade molding part 64 along a axial line of the hub 10, a shroud molding part 66 is formed to mold a linear section part 21of a shroud, an outside surface 23B of a step part 22 and a curve section part 25.

The above-constructed turbofan according to the embodiment of the present invention, the lower mold pattern 51 and the upper mold pattern 61 are arranged to be

assembled/disassembled along an axial line direction of the hub 10. A molten synthetic resin is then injected in the molding space provided by the assembly of the lower mold pattern 51 and the upper mold pattern 61. After the injected synthetic resin has been hardened, the lower mold pattern 51 and the upper mold pattern 61 are separated from each other. The molded turbofan is then separated from the lower mold pattern 51.

[Effect of the invention]

As so far described, the present invention provides a turbofan which enables to elongate durability by preventing a sharp edge from occurring in the mold for the turbofan fabrication, a method manufacturing the same, and a mold pattern by having a turbofan according to the present invention, comprising a hub having a boss part and a guide part; a linear section part having an inner diameter equal to or longer than a maximum outer diameter of the hub; a step part extending from the linear section part along a radial direction of the hub at a predetermined distance; a shroud having a step section part curved so as to increase an inner diameter of the shroud gradually when getting closer to the hub; and a plurality of blades arranged along an axial line of the hub so as to be coupled with the hub and the shroud in one body.

Moreover, the turbofan according to the present invention enables to decrease weight and materials by making the linear section part thinner than the curve section part.

What is claimed is:

1. A turbofan comprising:

a boss part formed so as to receive a rotational shaft of a driving device at a central part;

a hub having a guide part extending from the boss part along a radial direction so as to guide airflow;

a linear section part separated from the hub at a predetermined distance in an axial line direction of the rotational shaft, arranged to a side of air inflow, and formed to have an inner diameter of the linear section part which is equal to or longer than a maximum outer diameter of the hub;

a step part curved to extend from the inner diameter surface of the linear section part at a predetermined distance along a radial direction of the hub, a shroud having a curve section part curved to increase the inner diameter of the shroud gradually when getting closer to the hub from the step part along the rotational axial line direction so as to guide airflow with the hub reciprocally; and

a plurality of blades each of which has one end coupled with the hub and the other end coupled with the curve section part in the rotational axial line direction and which are molded to form one body with the hub and the shroud at equiangular intervals along a circumferential direction of the hub.

2. The turbofan of claim 1, wherein a distance at which the step part extends is preferably equal to or longer than 1mm.

3. The turbofan of claim 1 or claim 2, wherein an outer surface is formed

between an outer diameter surface of the linear section part and an outer diameter of the curve section part. The linear section part is preferably equal to or thinner than the curve section part.

4. A turbofan comprising:

a hub having a boss part formed so as to receive a rotational shaft of a driving device at a central part,

a linear section part separated from the hub at a predetermined distance in an axial line direction of the rotational shaft, arranged to a side of air inflow, and formed to have an inner diameter of the linear section part which is equal to or longer than a maximum outer diameter of the hub,

a step part extending from the inner diameter surface of the linear section part at a predetermined distance along a radial direction of the hub,

a shroud having a curve section part formed to be curved to increase the inner diameter of the shroud gradually when getting closer to the hub from the step part along the rotational axial line direction and be equal to or thicker than the linear section part so as to guide airflow with the hub reciprocally, and

a plurality of blades whose ends are coupled with the hub and other ends are coupled with the curve section part in the rotational axial line direction and which are molded to form one body with the hub and the shroud at equiangular intervals along a circumferential direction of the hub, and

a method for fabricating a turbofan, comprising the steps of:

arranging a lower mold pattern comprising a hub molding part for molding a lower surface of the hub on an upper surface of the hub molding part, a blade molding part protruding from a circumferential end of the hub molding part in the rotational axis

line direction so as to mold a portion of each of the blades, a shroud molding part curved for molding a lower surface of the shroud at an upper area of the blade molding part, and a step molding part extending at a predetermined distance along a radial direction of the hub so as to form a step between the blade molding part and the shroud molding part; and an upper mold pattern comprising a hub molding part for molding an upper surface of the hub on a lower surface of the hub molding part, a blade molding part formed to be inserted from a circumferential end of the hub molding part along an inner side of the blade molding part of the lower mold pattern and molding a portion of each of the blades, a linear section molding part separated from the step part at a predetermined distance in the axial line direction of the rotational shaft and having a predetermined thickness from the step part so as to mold a linear section part of the shroud, and a shroud molding part extending to be parallel with the step part at a predetermined distance and curved so as to mold an upper surface of the curve section part of the shroud.;

arranging so as to make the upper mold pattern and the lower mold pattern assemble together;

injecting a molten synthetic in the inside space provided by the assembly of the upper mold pattern and the lower mold pattern;

separating each other; and

separating the molded turbofan from one of the upper mold pattern and the lower mold pattern.

5. In fabricating a turbofan comprising:

a hub wherein a boss part formed so as to receive a rotational shaft of a driving device;

a linear section part separated from the hub at a predetermined distance in an axial

line direction of the rotational shaft, arranged to a side of air inflow, and formed having an inner diameter of the linear section part which is equal to or longer than a maximum outer diameter of the hub;

a step part having a predetermined thickness from the inner diameter surface of the linear section part and extending at a predetermined distance in a radial direction of the hub;

a shroud having a curve section part curved to increase the inner diameter of the shroud gradually when getting closer to the hub from the step part along the rotational axial line direction and be equal to or thicker than the linear section part so as to guide airflow with the hub reciprocally; and

a plurality of blades, each of which has one end coupled with the hub in one body and has the other end coupled with the curve section part in one body in the rotational axial line direction, separated/arranged at equiangular intervals along a circumferential direction of the hub,

a mold for manufacturing a turbofan, comprising:

a lower mold pattern comprising:

a hub molding part for molding a lower surface of the hub on an upper surface of the hub molding part;

a blade molding part protruding from a circumferential end of the hub molding part in the rotational axial line so as to mold a portion of each of the blades; and

a shroud molding part curved for molding a lower surface of the shroud at an upper area of the blade molding part, and

a step molding part extending at a predetermined distance along a radial direction of the hub so as to form a step between the blade molding part and the shroud molding part, and

an upper mold pattern comprising:

a hub molding part for molding an upper surface of the hub on a lower surface of the hub molding part;

a blade molding part formed to be inserted from a circumferential end of the hub molding part along an inner side of the blade molding part of the lower mold pattern and molding a portion of each of the blades;

a linear section molding part separated from the step part at a predetermined distance in the axial line direction of the rotational shaft, and having a predetermined thickness from the step part so as to mold a linear section part of the shroud; and

a shroud molding part extending to be parallel with the step part at a predetermined distance and curved so as to mold an upper surface of the curve section part of the shroud.